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EXAMINER	
RUGGLES, JOHN S	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/689,547	CROCKER ET AL.	
	Examiner	Art Unit	
	John Ruggles	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 April 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,7-13,17-23,25,29-41,44-46,98 and 99* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,7-13,17-23,25,29-41,44-46,98 and 99* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

In the current 4/3/08 amendment submission, the status of each claim is as follows:

claims 1, 34-35, 40 are *currently* ***amended***,

claims 2-3, 7-13, 17-23, 25, 29-33, 36, 41, 44-46 remain as *original*,

claims 4-6, 14-16, 24, 26-28, 42-43, 47-97, 100-101 are now **cancelled**, and

claims 37-39, 98-99 remain as *previously presented*.

Therefore, only claims 1-3, 7-13, 17-23, 25, 29-41, 44-46, and 98-99 remain under consideration as currently amended and as further limited by the previously elected specie (2) drawn to only methods of repairing or making phase shift masks (PSMs) for radiation lithography.

The previous specifically exemplified objections to the specification numbered (7)-(8) are withdrawn in view of current specification amendments, but the remaining exemplified specification objections (9) (a)-(d) are maintained in this Office action along with further examples of objections to the specification as listed below.

The previous art rejections under 35 U.S.C. 103(a) are re-written below as necessitated by Applicants' current amendment and accompanying remarks, to which responses are provided in this Office action.

Specification

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification must be revised carefully in order to comply with 35 U.S.C. 112,

first paragraph. Examples of some remaining unclear, inexact or verbose terms used in the specification are: (9) (a) on page 22 at line 1, the section heading for Example 4 has been misspelled due to missing letters in the words of this heading that must be corrected appropriately; and similar misspellings due to missing letters also exist at least (b) on page 23 in the Part 3: section heading, (c) on page 29 in the Part 6: section heading, (d) on page 32 in the Part 7: section heading; (10) in the paragraph bridging pages 8-9 at lines 1-3, "a mask made by *conventional* methods with features otherwise difficult to fabricate, for example *(* xxvii) to add OPC (optical *phase* correction) features" (emphasis added by italics) should be corrected as --a mask made by *conventional* methods with features otherwise difficult to fabricate, ~~for example (xxvii) to add~~ (xxvii) by addition of OPC (optical ~~*phase*~~ proximity correction) features--, in order to improve clarity and be more consistent with conventional terminology; and (11) in line 1 on page 16, "can and can serve" is repetitive and should be changed to --can ~~and can~~ serve--. Note that due to the number of errors, those listed here are merely *examples* of the corrections needed and do *not* represent an exhaustive list thereof.

Appropriate correction is still required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 7-13, 17-23, 25, 29-34, 36-41, 44-46, and 98-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lewis et al. (7/21/04 IDS cite # A49), Miller (US 6,270,946), either Park et al. (US 5,871,869) or Starodubov (US 5,972,542), Ukrainczyk (US 6,253,015) and Mancevski (US 6,146,227).

Lewis et al. teach a process of repairing a mask by delivering liquid or gas through a cantilevered hollow micropipette attached to an atomic force microscope (AFM) tip or probe head, allowing nanometric spatial control of specifically localized chrome etching to be demonstrated without detectable effects on the underlying glass substrate of the mask (abstract, *instant claims 2, 36-39, 41, 46*). For the micropipette, a quartz nanopipette can have an outer diameter at the tip of 10nm and a hole in the middle that can be as small as 3nm (p2689/left col., which is clearly capable of repairing defects that are of similar or larger size, reading on *instant claims 9-13*). A reflective metal layer on the backside is used to detect bending movement of the AFM cantilever (Figure 1, p2689/right col.). The width of etched lines includes specific examples at 100nm and 1,150nm, with the depth (or height) exemplified by 120nm and 200nm, respectively (p2691/left col., *instant claims 20-23*). Contemplated variations specifically include the use of intermittent contact-mode AFM delivery similar to that achieved by an ink jet printer, controlled distribution or confinement of liquid between the pipette or hollow tip and the substrate treated by altering the geometry or the surface of the hollow pipette tip to be either hydrophobic or hydrophilic, or alternative equipping of the pipette or hollow tip of an AFM to apply an electrical voltage or illumination on the surface treated to further improve resolution of the pattern formed or repaired (e.g., on the mask, etc.). This technology has wide implications

both for the use of this methodology in controlled nanochemistry with liquids or reactive gases (p2691/right col.). For the purpose of this rejection, the contact-mode AFM delivery similar to that achieved by an ink jet printer (which is very well known for selectively depositing ink as coating material) is interpreted as being inherently capable of additive patterning by using a coated AFM tip to deliver coating material for selectively making or repairing a patterned mask. Also in this rejection, the controlled distribution or confinement of liquid between the hollow tip and the substrate treated by altering the geometry or the surface of the hollow tip to be either hydrophobic or hydrophilic is understood to facilitate transfer of liquid such as coating material from the tip to the surface treated (e.g., to repair a nanometer scale missing part or clear defect on a patterned mask by depositing an opaque material such as Cr [noting that it is well known in the metal coating art that a metal coating can be derived from post-treatment of a deposited precursor material or compound containing such metal to convert the deposited precursor into the desired metal coating], etc., *instant claims 7-8, 18, 25, 30, 34, 44*). This further suggests the suitability of an AFM having a tip coated with material for delivery to a desired substrate to effect additive repair of a patterned mask and/or a desired etchant for subtractive repair of a patterned mask, without requiring any voltage bias between the AFM tip and the desired substrate or the mask, and also without requiring any vacuum conditions during such treatment of the desired substrate or the mask (*instant claims 31, 98-99*).

The teachings of Lewis et al. discussed above that include the finely controlled selective delivery of liquid material from an AFM having a hollow tip coated with the liquid material onto a defective patterned mask for repair of defects on the mask is interpreted in this rejection to primarily focus on subtractive repair of defective patterned masks by etching to remove excess

defects (e.g., to remove excess opaque Cr defects from a patterned mask, etc.). Even though alternatively contemplating the potential suitability of using an AFM tip to selectively deposit material for additive repair of a defective patterned mask (as discussed above), Lewis et al. do not teach specific examples or any detailed description of such additive repair for patterned masks. Also, Lewis et al. do not specifically teach using a sol-gel coating material (*instant claims 1, 40*) for additive patterning or repairing of a mask, such as a PSM.

Miller teaches a process of patterning and/or building up layered nanoscale features on a substrate by selectively applying first and second materials with a nanoscale delivery device. A first difunctional molecule is applied and reacted with a surface of the substrate and a second difunctional molecule is applied and reacted with previously unreacted functional groups from the first difunctional molecule to form a patterned layer on the surface of the substrate (title, abstract). The difunctional molecule may be any that is known to those skilled in the art, such as a difunctional monomer, oligomer, or polymer. The number of repeating units in the backbone of the molecule can range from one to thousands (1 to 1,000s, which clearly reads on high molecular weight compounds*, instant claim 29*), depending on the final application and intended use (c2/L39-48). Any known substrate material can be used; particularly materials such as glass, metal (Au), silicon (Si), polymers, or germanium (Ge) are given as examples of suitable substrate materials (c2/L59-67). Any device known to those skilled in the art may serve as the nanoscale delivery device. Figure 2 shows the device 40, in general, comprising a probe 50 having a microfluidic device 60 attached thereto. One type of probe used is a proximal probe from an atomic force microscope (AFM). The microfluidic device forces or encourages the flow of the molecule to be applied to the surface of a substrate or another molecule. The probe may

be chemically treated to induce transfer. Alternatively or in addition to the chemical treatment, a carbon nanotube may be incorporated into the probe tip. These nanotubes function similarly to that of a (hollow) fountain pen, making it possible to transfer the difunctional molecule to the substrate or to direct placement of the difunctional molecule with respect to a previously reacted difunctional molecule. The nanoscale delivery device allows formation of an ultra small pattern for further processing into such devices as semiconductors or electronic devices in a cost effective, well-controlled manner (c3/L31-53). Reaction of the first and second difunctional molecules at functional groups can be enhanced by exposure to a radiation source, such as a scanning electron beam, x-rays, ultraviolet (UV) or visible light, or a thermal energy source (c2/L54-65, *instant claim 34*). The radiation energy source can be extended from a nanoscale delivery device, as previously described (c3/L33-34). AFM probes have been previously known to transfer a very small amount of chemical material onto a surface to form a very small feature (tens of nm in dimension, c1/L36-40, *instant claims 9-13*). As exemplified in step 6 of Figure 1, many multiple layers of either the same or different materials can be built up on a common substrate to form nanoscale features of the desired coating materials and total thickness, which are determined by the final application for the multilayered product (c4/L56 to c5/L9, *instant claims 19-23, 32-33, 45*).

Park et al. teach a method of manufacturing a PSM that includes patterning a PS layer (title, abstract). This PSM is usable for forming fine patterns in a semiconductor device (c1/L5-11). Figure 2 shows an example of a PSM having a (transparent) PS layer of a metal oxide (e.g., TiO_2, ZrO_2, CrO_2, ZnO_2, etc., *instant claim 25*) coated by a sol-gel method to yield a refractive index of about 1.6 to 2.3 on a transparent substrate (e.g., of soda lime glass, quartz, etc.). The

thickness of the PS layer (e.g., about 140nm to 310nm, etc.) formed from the sol-gel is determined from equation 1 based on the incident exposure wavelength (e.g., 365nm, etc.) and the refractive index of the PS layer, in order to shift the phase of the incident light by 180° (c3/L15-39, c4/L6-8).

Starodubov teaches a sol-gel process of applying silica sol onto a substrate and molding the sol to form a (transparent) solid glass layer having a desired structure/pattern for a PSM, or even for a reflective PSM having an additional reflective layer (c4/L41-56). Also see claims 8-9 for a sol-gel process to form a silica glass structure on a mask substrate (of a PSM, c11/L19-22, *instant claim 25*).

Ukrainczyk teaches that a glass layer 14 (waveguide core, which can be any suitable glass that is transparent to the desired wavelength) is preferably deposited by known sol-gel technique(s), because such technique(s) produce smoother surfaces with fewer defects (that could otherwise cause surface scattering of light at the interfaces between layers, e.g., between the core and a cladding, etc.), and the sol-gel coating can be selectively deposited on the substrate (undercladding) layer 12 (of e.g., high-silica glass, other glass, etc.) through opening(s) in a coating mask (c7/L38 to c8/L5).

Mancevski teaches the use of an AFM cantilever with a carbon nanotube tip for mask repair or possibly as a lithography tool (c4/L9-11). It is known to those skilled in the art that sol-gel deposition can be used to coat the inside of a template or porous membrane substrate (e.g., with semiconductor or catalyst material, etc.) by dipping it into a sol-gel solution, then the membrane substrate is removed from the sol-gel solution and dried (e.g., to form a coated hollow tip on the AFM cantilever, etc.). The form of the resulting coating on the substrate depends on

the temperature of the sol-gel solution and the time of contact between the sol-gel solution and the substrate. This sol-gel method can be used to deposit metal catalysts, such as Ni, Fe, or Co catalyst, instead of semiconductor materials (c8/L63 to c9/L7, c9/L13-14). Thus, it is feasible to dip sol-gel solution coating material or sol-gel catalyst (precursor, *instant claim 25*) material into or on the hollow tip of an AFM (e.g., without clogging the hollow tip, etc.). One of ordinary skill would further have recognized that the sol-gel solution coating material or the sol-gel precursor material could also be transported with fine control (before it is dried) by the AFM hollow tip to a desired region of the mask for additive repair of the mask.

It would have been obvious to one of ordinary skill in the art at the time of the invention in the subtractive patterned mask repair process using an AFM having a hollow liquid coated tip with extremely fine control over the removal of excess opaque material defects (as taught by Lewis et al.) to alternatively or even additionally extend the use of the extremely finely controlled AFM tip for additive repair of the patterned mask by distributing desired coating material from the AFM tip (that may be chemically treated to induce transfer) onto a substrate of any suitable known material (e.g., glass, metal, etc.), including building up plural layers of this coating material (as taught by Miller). This is because at least the glass and metal substrate materials considered suitable for coating and even building up plural layers of coating material (taught by Miller) would be compatible with patterning or repairing a finely patterned mask having a metal pattern on a glass substrate (as taught by Lewis et al.), which provides a reasonable expectation of success for additive repair of a clear deficiency defect in an opaque pattern on a finely patterned mask by using the finely controlled AFM having a liquid coated tip. This AFM having a liquid coated tip would also function as a nanoscale delivery device to allow

formation of an ultra small patterned feature (tens of nm in dimension) in a cost effective, well-controlled manner (as taught by Miller). Furthermore, this AFM having a liquid coated tip would also be suitable for extremely finely controlled selective coating and/or selective etching of electrically non-conductive substrates as well as conductive substrates, including multilayer structures of diverse materials (e.g., to repair a defective mask such as a PSM having a conductive metal pattern on a non-conductive substrate, etc.), because an AFM probe tip can be used with conductive and/or non-conductive substrates. It would also have been obvious to one of ordinary skill in the art at the time of the invention in the additive patterning processes to produce or repair a mask (e.g., a PSM, etc.) with extremely fine control over coating and/or etching steps by using a SPM probe tip, such as a hollow tip AFM probe (taught by Lewis et al. and Miller) that includes depositing a desired thickness of transparent PS sol-gel coating material on the PSM (as taught by Park et al. or Starodubov), because: (a) sol-gel coating methods are known to produce smoother surfaces with fewer defects (e.g., for coating transparent glass material on an optical substrate, etc., as taught by Ukrainczyk); (b) it is feasible to dip sol-gel solution coating material or sol-gel catalyst (precursor) material into or on the hollow tip of an AFM (e.g., without clogging the hollow tip, etc.) to be used for repairing a mask (as taught by Mancevski, e.g., for additive repair of the mask, etc.). This would provide a reasonable expectation of success for producing or repairing transparent PS material on a PSM by extremely finely controlled addition of sol-gel coating or precursor material on either electrically conductive or non-conductive substrates, including multilayer structures of diverse materials (e.g., to repair a mask such as a PSM having a conductive metal pattern on a non-conductive substrate by addition of sol-gel coating or precursor material that can be converted to a desired

solid oxide, such as a transparent metal oxide PS layer on a PSM as taught by Park et al. or a silica (SiO_2) glass structure on a PSM as taught by Starodubov, etc., *instant claims 1-3, 7-13, 17-23, 25, 29-34, 36-41, 44-46, and 98-99*).

Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lewis et al. (7/21/04 IDS cite # A49), Miller (US 6,270,946), either Park et al. (US 5,871,869) or Starodubov (US 5,972,542), Ukrainczyk (US 6,253,015), Mancevski (US 6,146,227), each as discussed above, and Kley (US 6,337,479).

While teaching most aspects of the instant claim, Lewis et al., Miller, either Park et al. or Starodubov, Ukrainczyk, and Mancevski do not specifically teach the use of plural tips on the AFM for repairing the mask (such as a PSM).

Kley teaches SPM inspection and/or modification of an object (title, abstract), in which the object is specifically exemplified as being a semiconductor fabrication mask that is modified or repaired and the desired resolution for the repair of the mask is on the order of a single molecule (1 Angstrom (0.1nm) or LESS, c1/L65-67). An electron beam from the SPM tip can be used to chemically break up material including polymers or to stimulate other chemical reactions (c53/L40-63). The SPM can be an AFM probe or a SEM probe (c54/L1). Figure 2 specifically shows an exemplary SPM or AFM probe 122-1 having plural cantilevers 136, each cantilever having a corresponding tip 138 (e.g., for precision control of plural subtractive and/or additive repair operations on a defective mask, etc., c7/L41-46,61-62, c7/L64 to c8/L7, c9/L41-47, c10/L23-24,30-37, *instant claim 35*).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention in the additive patterning processes to produce or repair a mask (e.g., a PSM, etc.) with

extremely fine control over coating and/or etching steps by using an SPM probe, such as a hollow tip AFM probe that includes depositing a desired thickness of transparent PS sol-gel coating material on the PSM (as taught by Lewis et al., Miller, either Park et al. or Starodubov, Ukrainczyk, and Mancevski) to use plural probe tips for modifying or repairing the mask (as taught by Kley), because this would provide a reasonable expectation of success for precision control of plural additive and/or subtractive repair operations on the mask (as taught by Kley), while obtaining the benefit of reduced processing time during the mask repair. This would also provide for extremely finely controlled addition of sol-gel coating material on either electrically conductive or non-conductive substrates, including multilayer structures of diverse materials (e.g., to repair transparent PS material on a PSM having a conductive metal pattern on a non-conductive substrate, etc., *instant claim 35*).

Claims 1-3, 7-13, 17-23, 25, 29-34, 36-41, 44-46, and 98-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lewis et al. (7/21/04 IDS cite # A49), Miller (US 6,270,946), either Park et al. (US 5,871,869) or Starodubov (US 5,972,542), Ukrainczyk (US 6,253,015), Mancevski (US 6,146,227), each as discussed above, and either Mirkin et al. '62004 (US 2003/0162004) or Mirkin et al. '42106 (US 2004/0142106).

Even though alternatively contemplating the potential suitability of using an AFM tip to selectively deposit material for additive repair of a defective patterned mask (as discussed above), Lewis et al. do not teach specific examples or any detailed description of such additive repair for patterned masks. Also, Lewis et al. do not specifically teach using a sol-gel coating material (*instant claims 1, 40*) for additive patterning or repairing of the defective patterned mask, such as a PSM.

The teachings of Miller, Park et al., Starodubov, Ukrainczyk, and Mancevski are discussed above. In addition to the basis for additive repair of a mask using a sol-gel coating material as set forth above, further motivation for this combination is provided by either of the following additional references.

Mirkin et al. '62004 teach direct-write nanolithography from the surface of a scanning probe microscope (SPM) tip (e.g., an AFM tip, etc., as shown in Figure 1) having a patterning compound thereon for contacting with a substrate to cause selective coating on the substrate (title, abstract). This direct-write nanolithography is also referred to as dip pen nanolithography (DPN), which allows ultrahigh resolution for mask fabrication using a wide variety of functional groups at a relatively low cost (abstract, [0019]). DPN selective printing (e.g., for high resolution masks, etc.) using sol-gel chemistry (coating material) provides a low temperature (which may be close to room temperature [0048]) method using precursors to produce a wide range of compositions (e.g., glasses, metal oxides, ceramics, etc.) in various forms with better purity and homogeneity than would be achieved with high temperature conventional processes [0043]. A metal oxide precursor inking composition can be placed on a tip (of an AFM probe) and transferred for selectively coating a desired substrate, which is then subsequently processed as needed [0049] (which may include heating to substantially complete the sol-gel process [0073]).

Mirkin et al. '42106 teach a direct write coating method by a conventional AFM tip using a sol-gel process for coating a magnetic material precursor solution in a pattern that can be post-treated at elevated temperature to generate magnetic features to form feature sizes ranging from several hundred nm down to 100nm or LESS, allowing deliberate control over feature size and

shape, as well as interfeature distance and location (title, abstract). Other advantages include the use of relatively inexpensive instrumentation, good alignment and resolution, and versatility in compositions that can be deposited under controlled conditions [0018]. AFM tips are particularly preferred and the depositing or coating step can be carried out by using a hollow tip, wherein the patterning ink is transported through the hollow aspect of the tip. Also, the depositing step can be carried out with use of a sol-gel precursor [0055], which implies using the AFM hollow tip to transport the sol-gel precursor for selective coating of the sol-gel precursor onto the desired substrate.

It would have been obvious to one of ordinary skill in the art at the time of the invention in the subtractive patterned mask repair process using an AFM having a hollow liquid coated tip with extremely fine control over the removal of excess opaque material defects (as taught by Lewis et al.) to alternatively or even additionally extend the use of the extremely finely controlled AFM tip for additive repair of the patterned mask by distributing desired coating material from the AFM tip (that may be chemically treated to induce transfer) onto a substrate of any suitable known material (e.g., glass, metal, etc.), including building up plural layers of this coating material (as taught by Miller). This is because at least the glass and metal substrate materials considered suitable for coating and even building up plural layers of coating material (taught by Miller) would be compatible with patterning or repairing a finely patterned mask having a metal pattern on a glass substrate (as taught by Lewis et al.), which provides a reasonable expectation of success for additive repair of a clear deficiency defect in an opaque pattern on a finely patterned mask by using the finely controlled AFM having a liquid coated tip. This AFM having a liquid coated tip would also function as a nanoscale delivery device to allow

formation of an ultra small patterned feature (tens of nm in dimension) in a cost effective, well-controlled manner (as taught by Miller). Furthermore, this AFM having a liquid coated tip would also be suitable for extremely finely controlled selective coating and/or selective etching of electrically non-conductive substrates as well as conductive substrates, including multilayer structures of diverse materials (e.g., to repair a defective mask such as a PSM having a conductive metal pattern on a non-conductive substrate, etc.), because an AFM probe tip can be used with conductive and/or non-conductive substrates. It would also have been obvious to one of ordinary skill in the art at the time of the invention in the additive patterning processes to produce or repair a mask (e.g., a PSM, etc.) with extremely fine control over coating and/or etching steps by using a SPM probe tip, such as a hollow tip AFM probe (taught by Lewis et al. and Miller) that includes depositing a desired thickness of transparent PS sol-gel coating material on the PSM (as taught by Park et al. or Starodubov), because: (a) sol-gel coating methods are known to produce smoother surfaces with fewer defects (e.g., for coating transparent glass material on an optical substrate, etc., as taught by Ukrainczyk); (b) it is feasible to dip sol-gel solution coating material or sol-gel catalyst (precursor) material into or on the hollow tip of an AFM (e.g., without clogging the hollow tip, etc.) to be used for repairing a mask (as taught by Mancevski, e.g., for additive repair of the mask, etc.); and either (c) selective printing by an AFM tip using sol-gel chemistry (coating material) for selectively coating a desired substrate (such as for repairing a high resolution mask) provides a low temperature method using a precursor to produce a wide range of compositions (e.g., glasses, metal oxides, etc.) in various forms with better purity and homogeneity than would be achieved with high temperature conventional processes (as taught by Mirkin et al. '62004) or (d) selective direct write coating by

a conventional AFM tip (e.g., with a hollow tip, etc.) using a sol-gel process for coating a precursor solution onto a desired substrate (such as for repairing a mask) allows deliberate control over feature size and shape, as well as interfeature distance and location, while including the use of relatively inexpensive instrumentation, good alignment and resolution, and versatility in compositions that can be deposited under controlled conditions (as taught by Mirkin et al. '42106). This would provide a reasonable expectation of success for producing or repairing transparent PS material on a PSM by extremely finely controlled addition of sol-gel coating or precursor material on either electrically conductive or non-conductive substrates, including multilayer structures of diverse materials (e.g., to repair a mask such as a PSM having a conductive metal pattern on a non-conductive substrate by addition of sol-gel coating or precursor material that can be converted to a desired solid oxide, such as a transparent metal oxide PS layer on a PSM as taught by Park et al. or a silica (SiO_2) glass structure on a PSM as taught by Starodubov, etc., *instant claims 1-3, 7-13, 17-23, 25, 29-34, 36-41, 44-46, and 98-99*).

Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lewis et al. (7/21/04 IDS cite # A49), Miller (US 6,270,946), either Park et al. (US 5,871,869) or Starodubov (US 5,972,542), Ukrainczyk (US 6,253,015), Mancevski (US 6,146,227), either Mirkin et al. '62004 (US 2003/0162004) or Mirkin et al. '42106 (US 2004/0142106), and Kley (US 6,337,479), each as discussed above.

While teaching most aspects of the instant claim, Lewis et al., Miller, either Park et al. or Starodubov, Ukrainczyk, Mancevski, and either Mirkin et al. '62004 or Mirkin et al. '42106 do not specifically teach the use of plural tips on the AFM for repairing the mask (such as a PSM).

The teachings of Kley are discussed above.

It would have been obvious to one of ordinary skill in the art at the time of the invention in the additive patterning processes to produce or repair a mask (e.g., a PSM, etc.) with extremely fine control over coating and/or etching steps by using an SPM probe, such as a hollow tip AFM probe that includes depositing a desired thickness of transparent PS sol-gel coating material on the PSM (as taught by Lewis et al., Miller, either Park et al. or Starodubov, Ukrainczyk, Mancevski, and either Mirkin et al. '62004 or Mirkin et al. '42106) to use plural probe tips for modifying or repairing the mask (as taught by Kley), because this would provide a reasonable expectation of success for precision control of plural additive and/or subtractive repair operations on the mask (as taught by Kley), while obtaining the benefit of reduced processing time during the mask repair. This would also provide for extremely finely controlled addition of sol-gel coating material on either electrically conductive or non-conductive substrates, including multilayer structures of diverse materials (e.g., to repair transparent PS material on a PSM having a conductive metal pattern on a non-conductive substrate, etc., *instant claim 35*).

Response to Arguments

On page 8 of the remarks section in the current 4/3/08 amendment submission, Applicants contend that they cannot find any misspelled headings (due to missing letters) at all in the specification (in reference to the previous specification objections (9) (a)-(d), which are maintained above). Applicants should carefully review the image file wrapper (IFW) scanned images for the 50-page original 10/21/03 specification, which are available in PAIR. This IFW original specification filed on 10/21/03 clearly illustrates such defective headings (having

misspelled text due to missing letters) in at least each of the locations pointed out previously and again set forth above as specification objections (9) (a)-(d).

Applicants' arguments on pages 8-9 of 10 in the current 4/3/08 amendment submission with respect to claims 1-3, 7-13, 17-23, 25, 29-41, 44-46, and 98-99 have been considered, but they are either moot or unpersuasive in view of the new or revised ground(s) of rejection in this Office action, as necessitated by the current amendment and accompanying remarks.

On pages 8-9, Applicants now rely on the description in Lewis et al. at p2690/left col. to show that "solidification *can be* prevented" (emphasis added by italics) when an "Etchant which leaves the pipette forms globules which solidify on the surface" to hinder the writing process **during etching** to selectively remove material from the surface (of the mask being repaired). However, the benefit of optionally preventing solidification during etching does **not** go against or contradict the additive repair of a mask ***during coating***, as asserted by Applicants, because in this coating method solidification of the added coating material is clearly desirable and even necessary. In fact, Lewis et al. alternatively contemplate the potential suitability of using an AFM tip to selectively deposit material for additive repair of a defective patterned mask (as discussed above). Therefore, one of ordinary skill in the art would have recognized that solidification of a desired coating material during additive repair of a defect on the mask would have been beneficial for keeping the added material in place on the mask.

In response to Applicants' arguments against the references individually (such as Lewis et al. alone), one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In addition, any deficiency of Lewis et al. (as asserted by Applicants) is covered by the other cited references for at least the reasons given above. In particular, Miller teaches a process of patterning and/or building up layered nanoscale features on a substrate by selectively applying first and second materials with a nanoscale delivery device. Park et al. and Starodubov each show the addition of sol-gel coating material to a PSM. Ukrainczyk provides the motivation for using the known technique of sol-gel coating and Mancevski clearly shows the feasibility of using an AFM tip to transport and apply a sol-gel coating material with fine control (e.g., for additive repair of a mask defect, etc.). Furthermore, Mirkin et al. '62004 and Mirkin et al. '42106 each cover the use of an AFM tip for selective coating by direct-write nanolithography or dip pen nanolithography (DPN) on a substrate (e.g., for sol-gel deposition of a solid oxide coating material on a substrate, etc.).

Also on page 9, Applicants take the position that none of the references teach the use of a photomask in need of additive repair, rather than subtractive repair. However, both additive and subtractive repair of masks have been well-known in the mask repair art for many years. For example, see Tao et al. (10/25/05 IDS cite # C2) for repair of mask defects by either etching or coating, which is additive repair of the defects on the mask. Alternatively, Yedur et al. (title, abstract, 3/16/06 IDS cite # D1) shows the repair of very small defects on a mask by either etching or coating as additive repair of the mask.

In response to Applicants' additional argument on page 9 that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references

themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the particular reasons for combining the references in the re-written rejections of this Office action are presented and discussed above.

Applicants' prior remarks incorporated on page 9 have already been addressed in previous Office actions.

Therefore, the current arguments presented by Applicants are still unpersuasive.

Conclusion

Applicants' amendment necessitated the new or revised ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is (571)272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jsr

/Mark F. Huff/
Supervisory Patent Examiner, Art Unit 1795